

**What is claimed is:**

1. An isolated nucleic acid molecule comprising a nucleic acid, which corresponds to BMP-2 regulatory region, comprising an estrogen responsive element.
- 5 2. A vector comprising the nucleic acid according to claim 1, wherein the nucleic acid is operably linked to a second nucleic acid.
3. A host cell comprising the vector of claim 2.
- 10 4. The host cell of claim 3, wherein the cell further comprises an estrogen receptor.
5. The host cell of claim 4, wherein the estrogen receptor is  $\alpha$ .
- 15 6. The host cell of claim 4, wherein the estrogen receptor is  $\beta$ .
7. A method for the identification of a therapeutic agent for the prevention and/or treatment of osteoporosis, comprising:
  - (a) introducing into a cell the vector of claim 2;
  - 20 (b) contacting the cell with a candidate agent; and
  - (c) monitoring the expression of the protein encoded by the reporter nucleic acid, wherein induced expression of the protein indicates that the candidate agent is a potential therapeutic agent.
- 25 8. The method of claim 7, wherein in step (a) a second expression vector comprising a nucleic acid molecule encoding an estrogen receptor is introduced into the cell.
9. The method of claim 8, wherein the estrogen receptor is  $\alpha$ .
- 30 10. The method of claim 8, wherein the estrogen receptor is  $\beta$ .

11. A method of regulating expression of BMP-2 in a subject comprising the steps of: administering the vector of claim 2, wherein said second nucleic acid encodes for the BMP-2; and administering to the subject an effective amount of estrogen or estrogen agonist; thereby regulating expression of BMP-2 in the subject.

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12 A method of regulating expression of BMP-2 in a subject comprising the steps of: administering to the subject an effective amount of the cell of claim 3, wherein the a second nucleic acid encodes for BMP-2; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby regulating expression of BMP-2 in the subject.

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13 The method of claim 12 wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

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14. A method of increasing responsiveness of a cell to an estrogen or estrogen agonist comprising the step of administering the vector of claim 2; thereby increasing the responsiveness of the cell to estrogen.

15. The method of claim 14, wherein the cell comprises an estrogen receptor.

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16. The method of claim 14, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

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17. A method of enhancing repair of a bone in the body in a subject in need comprising the steps of: administering the vector of claim 2; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby enhancing repair of the bone in the body of the subject in need.

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18. A method of enhancing repair of a bone comprising the steps of: administering to a subject an effective amount of the cell of claim 3; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby enhancing repair of the bone in the subject.

19. The method of claim 18, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

20. A method for maintaining or increasing bone volume, bone quality, or bone strength in a subject in need afflicted with osteoporosis caused by or accompanied by a decrease in estrogen comprising the steps of: administering the vector of claim 2; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby maintaining or increasing bone volume, bone quality, or bone strength in the subject in need.

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21. A method for maintaining or increasing bone volume, bone quality, or bone strength in a subject in need afflicted with osteoporosis caused by or accompanied by a decrease in estrogen comprising the steps of: administering to a subject an effective amount of the cell of claim 3; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby maintaining or increasing bone volume, bone quality, or bone strength in the subject in need.

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22. The method of claim 21, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

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23. A method of enhancing repair of a bone in the body in a subject in need comprising the steps of: obtaining a cell from the subject; transfecting the cell with the vector of claim 2; administering the engineered cell to the subject; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby enhancing repair of a bone in the body in the subject in need.

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24. A method for maintaining or increasing bone volume, bone quality, or bone strength in a subject in need afflicted with osteoporosis caused by or accompanied by a decrease in estrogen comprising the steps of: obtaining a cell from the subject; transfecting the cell with the vector of claim 2; administering the engineered cell to the subject; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby maintaining or increasing bone volume, bone quality, or bone strength in a subject in need.

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25. The method of claim 24, wherein the step of administering to the subject in need an effective amount of estrogen or estrogen agonist further increase the level of expressed BMP 2 by 1.5-30 fold.

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26. The method of claim 24, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

27. A method for the production of transplantable bone matrix, the method comprising the steps of: obtaining a cell; transfecting the cell with the vector of claim 2; and culturing the cell with the cell-associated matrix for a time effective for allowing formation of a transplantable bone matrix.

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28. The method of claim 27, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

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29. A method of stimulating osteoblast differentiation comprising the steps of: administering the vector of claim 2; and administering an effective amount of estrogen or estrogen agonist; thereby regulating expression of stimulating osteoblast differentiation.

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30. A method of treating a bone disease in a subject comprising the steps of: administering the vector of claim 2; and administering to the subject an effective amount of estrogen or estrogen agonist; thereby treating a bone disease in the subject.

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31. A method of treating a bone disease in a subject comprising the steps of: administering to the subject an effective amount of the cell of claim 3; and administering to the subject in need an effective amount of estrogen or estrogen agonist; thereby treating a bone disease in the subject.

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32. The method of claim 31, wherein the cell is a mesenchymal stem cell, a progenitor cell, or a cell capable of differentiating into an osteoblast cell.

33. A method for identifying a compound in a sample as an estrogenic agonist comprising:

(a) providing a cell line expressing receptors for human estrogen, which cell line has been stably transfected by a vector comprising a reporter nucleic acid operatively linked to an isolated nucleic acid corresponding to BMP-2 regulatory region, or a fragment thereof that comprises an estrogen responsive element, wherein said estrogen responsive element is capable of controlling expression of the reporter nucleic acid in response to estrogen;

(b) contacting the transfected cell line with a sample suspected to contain a human estrogen agonist, under conditions in which human estrogen would cause increased expression of the reporter nucleic acid; and

(c) measuring the level of expression of the reporter nucleic acid,

Whereby a human estrogen agonist in the sample is identified by measurement of an increased level of expression of the reporter nucleic acid, compared to the level produced by a buffer control.

34. A method for identifying a compound in a sample as a human estrogen antagonist comprising:

(a) providing a cell line expressing receptors for human estrogen, which cell line has been stably transfected by a vector comprising a reporter nucleic acid operatively linked to an isolated nucleic acid corresponding to BMP-2 regulatory region, or a fragment thereof that comprises an estrogen responsive element wherein said estrogen responsive element is capable of controlling expression of the reporter nucleic acid in response to estrogen;

(b) contacting the transfected cell line with a sample suspected to contain a human estrogen antagonist, to which has been added an amount of human estrogen that, absent such antagonist, would produce a measurable increase in expression of the reporter nucleic acid; and

(c) measuring the level of expression of the reporter nucleic acid,

whereby a human estrogen antagonist in the sample is identified by measurement of a decreased level of expression of the reporter nucleic acid, compared to the level produced by the human estrogen in the absence of such antagonist.